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The Correlation Between the Macroeconomic Indicator PMI and Private Equity Investment

Youran Zhang[1,a,*]

[1]*The Experimental High School Attached To Beijing Normal University, Beijing, 100032, China*
a. zhangf.2003@tsinghua.org.cn
**corresponding author*

Abstract: This paper presents an in-depth analysis of the correlation between China's manufacturing PMI and private equity investment from 2015 to 2022, utilizing correlation and regression analysis methods based on both overall and structural data. The findings reveal a moderate correlation between manufacturing PMI and private equity investment. Specifically, manufacturing PMI demonstrates a predictive effect on private equity investment, with a lead time of one to two quarters. This accounts for 27.7% of the variation in private equity investment. Furthermore, employing the VAR model, this study observes a significant positive effect of manufacturing PMI on private equity investment, with significant positive impacts found during the two and six lagged periods. These results align with the leading indicator characteristic of PMI and suggest that private equity investment serves as a "barometer" for the capital market. Additionally, this paper investigates the correlation between manufacturing PMI and different stages of private equity investments (early, venture capital (VC), and PE investments) while also analyzing the correlation between manufacturing PMI and private equity investments from different funding sources, including RMB and foreign currency private equity investments. The results indicate that, akin to private equity investment in general, early, VC, and PE investments exhibit varying degrees of correlation with manufacturing PMI. Moreover, foreign currency private equity investment demonstrates a stronger correlation with manufacturing PMI compared to RMB private equity investment.

Keywords: macroeconomic indicator, private equity investment, correlation

1. Introduction

Private equity investment is a key element of the innovation and entrepreneurship ecosystem and is instrumental in promoting high-quality economic development. As widely recognized across various sectors, it is essential to increase efforts to promote the sound and standardized development of private equity investment. The Purchasing Managers' Index (PMI) serves as an internationally recognized macroeconomic monitoring indicator and acts as a leading indicator for economic monitoring. Zhu's research on the current development of private equity funds and countermeasures emphasizes the importance of private equity as a prominent representative form of direct financing [1]. Leveraging its professional and flexible advantages, private equity provides vital financial assistance to non-listed companies, particularly high-quality companies that may not meet the necessary conditions for bank loans. This support helps drive the progress of these businesses and plays a significant role in the

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development of real economy. Huang highlights the positive impact of private equity investment on corporate value and performance [2]. Introducing private equity investment significantly enhances corporate value and performance. Some scholars have also provided insights into the relationship between manufacturing PMI and the stock market. Sheng and Yang note that the month-on-month growth rate of manufacturing PMI has a positive impact on the monthly returns of the Shanghai Shenzhen CSI 300 [3]. Zhang finds that PMI affects the CSI 800 [4]. However, Yang indicates that the effect of manufacturing PMI on the Shanghai Shenzhen CSI 300 is relatively small, with the most significant effect observed in the first two months after its release, followed by a diminishing effect [5]. Nevertheless, no comprehensive literature analyzing the correlation between PMI and private equity investment currently exists. Undoubtedly, timely monitoring, analysis, and forecasting of investment conditions constitute fundamental prerequisites for promoting sound and standardized development. This study utilizes comprehensive survey data from PEDATA to quantitatively analyze the correlation between the macroeconomic indicator PMI and private equity investment by selecting a reasonable time interval. Additionally, it validates the analysis of the correlation between the structural indicators of private equity investment and PMI, visually presenting the relationship between private equity investment and the macroeconomic indicator. In practice, this analysis enhances the government's targeted macro guidance, improves the financial support system for innovation, and improves the feasibility of investment decision-making for investors.

The data used for this study regarding private equity investment is sourced from PEDATA, a professional SAAS system for private equity investment under Zero2IPO. PEDATA collects data through market research, interviews, and public sources. The manufacturing PMI data is obtained from the website of the National Bureau of Statistics of China. Private equity investment emerged in China during the 1990s. In 2013, the Asset Management Association of China was established, marking the beginning of self-regulation in the industry. In this paper, quarterly data on private equity investment from 2015 to 2022 is selected. During this period, the regulation of the private equity fund industry was gradually improved; revisions were made to the Securities Investment Fund Law, Securities Law, and Interim Measures for the Supervision and Administration of Private Investment Funds; and new asset management regulations and numerous self-regulatory documents were introduced. Private equity investment experienced rapid growth, consolidation and standardization, incremental development, and a mild recovery in this period, making the data rich and representative for the analysis. Corresponding manufacturing PMI data from 2014 to 2022 is also selected to capture the correlation between private equity investment and manufacturing PMI throughout the development process.

2. Correlation Analysis

2.1. Manufacturing PMI and Private Equity Investment

In China, the released PMI indicators include manufacturing PMI, services PMI, and composite PMI. Calculations revealed that among the three indicators, manufacturing PMI exhibits a stronger correlation with private equity investment. Therefore, this study focuses on analyzing manufacturing PMI. As shown in Table 1, the correlation between manufacturing PMI and private equity investment from 2015 to 2022 was found to be 0.37. Considering the leading indicator characteristic of Manufacturing PMI in economic monitoring, it attempted to calculate the correlation between PMI and private equity investment by advancing PMI by one, two, three, and four quarters, respectively. It was found that advancing PMI by one quarter resulted in the highest correlation with private equity investment, which was 0.52. Advancing PMI by two quarters yielded a correlation of 0.51, indicating a moderate level of correlation. This implies that, in periods without significant disruptions,

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manufacturing PMI can be used to forecast changes in private equity investment one to two quarters in advance.

Table 1: Correlation between Manufacturing PMI and Private Equity Investment in different time interval.

	Private Equity Investment and PMI During the Same Period	Private Investment Lagging by One Period	Private Investment Lagging by Two Periods	Private Investment Lagging by Three Periods	Private Investment Lagging by Four Periods
Correlation	0.37	0.52	0.51	0.45	0.34

From an investment theory perspective, investors tend to expand their investments when the macroeconomic conditions improve and they become more risk-averse and decrease investment during economic downturns. In the context of private equity investment, which is considered a form of investment behavior in the capital market, the capital market serves as a "barometer" of the national economy and its performance is influenced by macroeconomic indicators. In practical operations, the changes in the PMI index, which is one to two quarters ahead, align with the operational characteristics of private equity funds. It is worth noticing that there is a natural process from fundraising to investment for private equity funds, apart from the funds that have already been raised and are ready to be invested. From an industry perspective, the top ten sectors in which private equity funds invest include information technology, business services, healthcare, consumer lifestyle, culture and sports, manufacturing, finance, electronic information, e-commerce, and automotive transportation. These industries exhibit a strong correlation with manufacturing PMI during the same period. Furthermore, government-guided funds constitute an important component of private equity investment. However, it is observed that the fundraising amount of these funds shows a correlation of 0.05 with manufacturing PMI, indicating a lack of significant correlation. This factor influences the degree of correlation between manufacturing PMI and private equity investment.

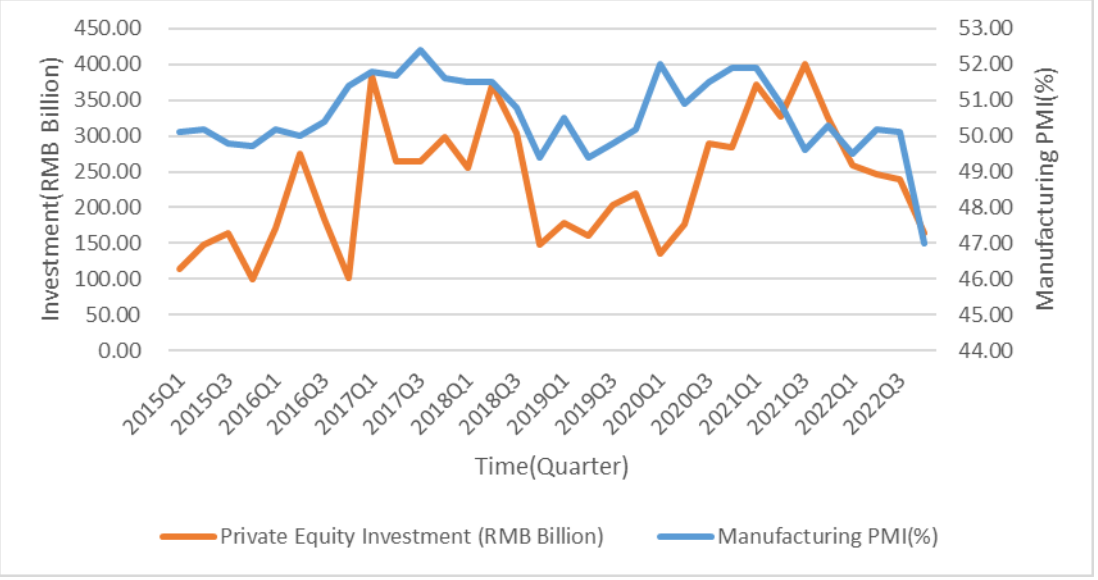

Figure 1: Correlation between Manufacturing PMI and Private Equity Investment.

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Figure 1 illustrates the trends in private equity investment over different years. Compared to the changes in manufacturing PMI, from 2015 to early 2017 and from late 2018 to late 2022, the two indicators generally exhibited similar trends for most of the time interval. Especially since 2020, private equity fund investments have been on an upward trajectory, reaching their peak in the third quarter of 2021. During the same period, manufacturing PMI peaked in the first quarter of 2021 but subsequently declined due to the impact of the COVID-19 pandemic. It is important to note that private equity fund investments are significantly influenced by policies. For instance, from early 2017 to early 2018, there was a noticeable divergence between private equity investment and manufacturing PMI trends. This period coincided with the year prior to the introduction of new regulations for asset management, which led to consolidation and differentiation within the asset management industry. As an important form of direct financing in the capital market, private equity fund investments are greatly affected by monetary policies and economic trends [6]. Another example is a steeper decline in private equity investment in 2018. During that year, there was a significant increase in the risk of stock pledges by major shareholders of listed companies, which negatively impacted market confidence. Additionally, the introduction of new asset management regulations further contributed to the decline in private equity investment, resulting in a more pronounced decrease compared to the manufacturing PMI. Another example is the growth of private equity funds since 2020. In addition to economic factors, the launch of the Science and Technology Innovation Board (STAR Market) and the implementation of the registration-based system for the Growth Enterprise Market (GEM) in 2019 also contributed to the growth of private equity fund investments. These initiatives have played a role in fostering the growth of private equity fund investments.

2.2. Manufacturing PMI and Private Equity Investments at Different Periods

Private equity funds raise capital to invest in promising startup companies [7]. These companies can be classified into different investments, including the seed stage, early stage, expansion stage, and maturity stage. In the second stage, early investments primarily target companies, typically within the first year of their establishment. VC investments, on the other hand, focus on early growth companies, usually within 1 to 3 years of their establishment. PE investments primarily target companies in the expansion and maturity stages.

Table 2: Correlation between Manufacturing PMI in different time intervals and Private Equity Investments in different stages.

Correlation	Private Equity Investment and PMI During the Same Period	Private Investment Lagging by One Period	Private Investment Lagging by Two Periods	Private Investment Lagging by Three Periods	Private Investment Lagging by Four Periods
Private equity investment (including early, VC, and PE investments)	0.37	**0.52**	0.51	0.45	0.34
Early investment	0.21	0.33	**0.44**	0.41	0.40
VC investment	0.18	0.40	**0.50**	0.47	0.44
PE investment	0.41	**0.53**	0.50	0.42	0.32

As shown in Table 2, the time intervals exhibiting the strongest correlation between private equity investments in different stages of companies and manufacturing PMI vary. For PE investment, similar

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to private equity investment as a whole, its strongest correlation with manufacturing PMI occurs when the latter leads the former by one quarter. In this case, the correlation was 0.53, slightly higher than that between manufacturing PMI and private equity investment, indicating a moderate correlation. Likewise, for early investment and VC investment, the strongest correlation with manufacturing PMI occurs when manufacturing PMI leads them by two quarters. The correlation for early investment is 0.44, and for VC investment, it is 0.5. This indicates that investments in companies that are within the first three years of their establishment are primarily focused on their medium to long-term growth potential. While these investments are correlated with the macroeconomic conditions at the time, their correlation is not as strong as that of PE investment.

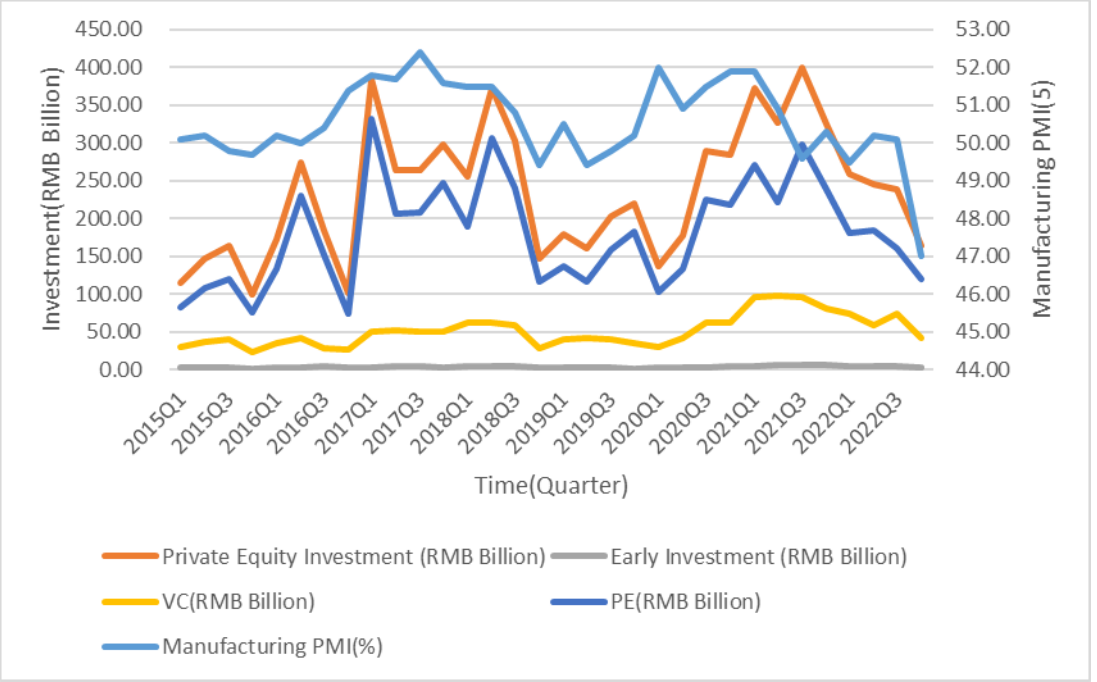

Figure 2: Correlation between Manufacturing PMI and Private Equity Investments in different stages.

(Photo/Picture credit: Original).

According to Figure 2, early investment and VC investment generally exhibit a similar trend to the overall private equity investment, albeit with slight differences. On the other hand, the trend of PE investment aligns more closely with the overall private equity investment trend.

2.3. Correlation Between Manufacturing PMI and Private Equity Investments from Different Funding Sources

Private equity investment funds can be classified into RMB and foreign currency private equity funds by the funding source. As indicated in Table 3, the correlation between foreign currency private equity investment and manufacturing PMI is 0.56, which is higher than the correlation for private equity investment as a whole. The highest correlation appears when the PMI leads by two quarters. This can be attributed to foreign currency funds having the ability to allocate resources globally and closely monitor the macroeconomic trends of specific countries. This global perspective enables them to make optimal investment decisions [6]. On the other hand, the correlation between RMB private equity investment and manufacturing PMI is 0.38, matching the time when the PMI leads by one quarter.

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Table 3: Correlation between Manufacturing PMI and Private Equity Investments from different funding sources in various time intervals.

Correlation	Private equity Investment and PMI During the Same period	Private Investment Lagging by One Period	Private Investment Lagging by Two Periods	Private Investment Lagging by Three Periods	Private Investment Lagging by Four Periods
Private equity investment (including early, VC, and PE investments)	0.37	**0.52**	0.51	0.45	0.34
RMB investment	0.24	**0.38**	0.33	0.26	0.19
Foreign currency investment	0.40	0.50	**0.56**	0.54	0.45

As depicted in Figure 3, the number of foreign currency private equity investments has shown a consistent decline since the beginning of 2021, reaching its lowest point in recent years [7]. Concurrently, manufacturing PMI has also been at its lowest level within the research period. In contrast, the trend of RMB private equity investment aligns more closely with the overall private equity investment.

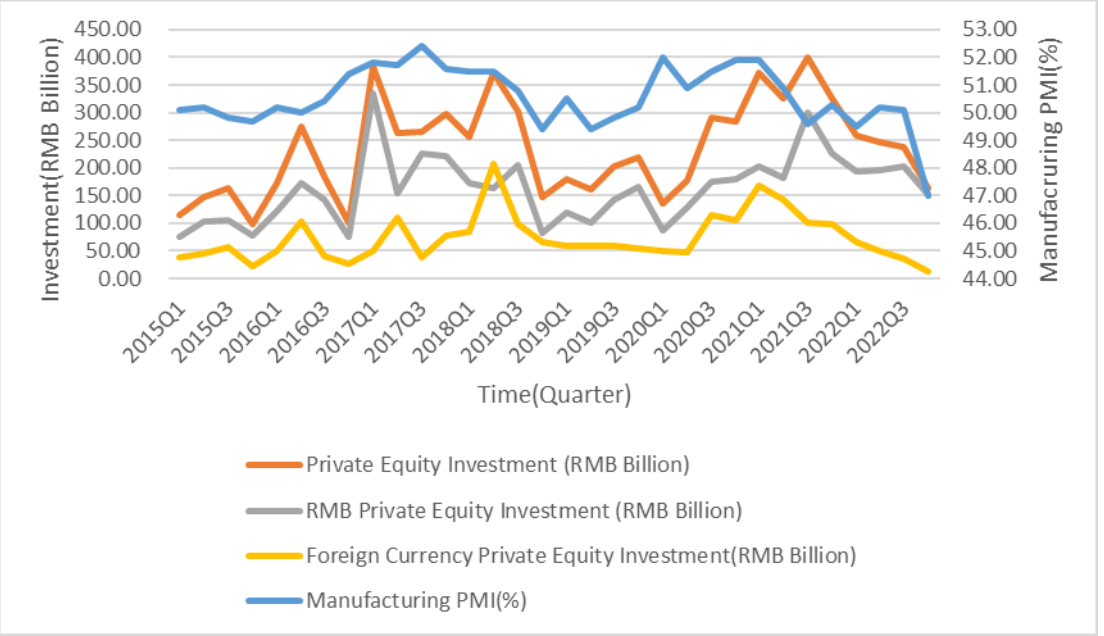

Figure 3: Correlation between Manufacturing PMI and Private Equity Investments from different funding sources (Photo/Picture credit: Original).

3. Regression Analysis

To further investigate the relationship between manufacturing PMI and private equity investment, this paper conducted a regression analysis. In this analysis, manufacturing PMI was treated as the independent variable (X), while private equity investment served as the dependent variable (Y) [8].

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Table 4: Regression analysis of Manufacturing PMI and Private Equity Investment.

Linear Regression Analysis Results (n=32)							
	Unstandardized Coefficient		Standardized Coefficient	*t*	*p*	Collinearity Diagnosis	
	B	Standard Error	*Beta*			VIF	Tolerance
Constant	-23403.238	7595.419	-	-3.081	0.004**	-	-
China's Manufacturing PMI (%)	508.341	149.890	0.526	3.391	0.002**	1.000	1.000
R 2□	0.277						
Adjusted *R2*□	0.253						
F□	*F* (1,30)=11.502, *p*=0.002						
D-W	1.510						
* *p*<0.05 ** *p*<0.01							

It can be observed from Table 4 that the R-squared value of the model is 0.277, indicating that China's manufacturing PMI (%) can explain 27.7% of the variation in private equity investment (in hundred million yuan). The F-test conducted on the model shows that the model passed the F-test (F=11.502, p=0.002<0.05). This indicates that China's manufacturing PMI (%) does produce a significant effect on private equity investment (in hundred million yuan). Based on the final analysis, the regression coefficient for China's Manufacturing PMI (%) is determined to be 508.341 (t=3.391, p=0.002<0.01). This implies that China's manufacturing PMI (%) has a significant positive effect on private equity investment (in hundred million yuan).

4. Model Analysis

4.1. Modeling

Unit root tests were conducted on private equity investment, early investment, VC investment, PE investment, RMB private equity investment, foreign currency private equity investment, and GDP from manufacturing. The results indicate that all variables, except for VC investment, passed the unit root test and exhibited stationary series. However, VC investment did not pass the Augmented Dickey Fuller (ADF) test. To address this, first-order differencing was applied to the data, which represents the quarterly growth of VC investment. Upon differencing, the series became stationary. Therefore, VAR models were established for private equity investment, early investment, PE investment, RMB private equity investment, foreign currency private equity investment, and GDP from manufacturing. Additionally, a VAR model was established for DiffVC and Diff Manufacturing PMI [9].

After considering various indicators and the impulse response and variance decomposition, it was found that the VAR model with a lag of three periods yielded the best results [10]. Therefore, for this study, the VAR model with a lag of three periods was selected as the preferred model. A further stability analysis was conducted by examining the characteristic root distribution plot of the VAR model. The AR characteristic root plot revealed that all the eigenvalues for both VAR models were within the unit circle. This indicates that there are no roots greater than 1 in the models, suggesting good stability of the constructed VAR models.

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4.2. Impulse Response

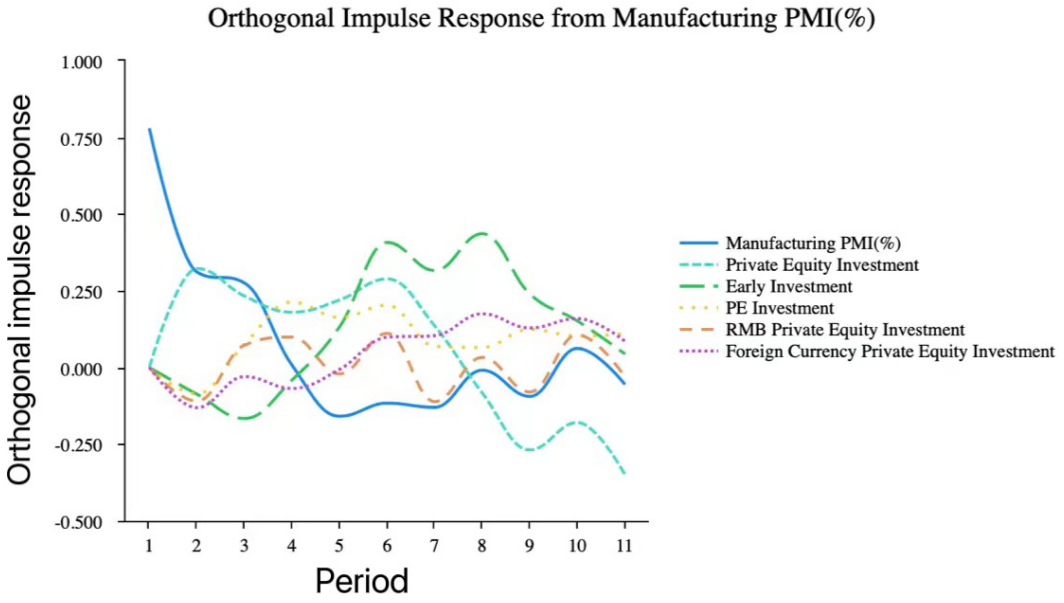

Figure 4: Impulse response of Private Equity Investment to Manufacturing PMI changes.

(Photo/Picture credit: Original).

The impulse response curve (see Figure 4) is used to describe the trajectory of the scattering degree as it changes over time. The impact of manufacturing PMI on private equity investment shows two positive peaks in the 2nd and 6th periods, with an influence degree of over 30%, followed by a decline, indicating that an increase in manufacturing PMI promotes the development of private equity investment for a certain period of time. However, its decline also affects the growth of private equity investment for a period of time. The impact of manufacturing PMI on early investment initially shows an inhibitory effect for the first three periods, with a maximum suppression influence of up to 20%. However, the positive impact gradually increases and peaks in the 6th and 8th periods at nearly 50%, followed by a subsequent decline. This indicates that an increase in PMI attracts more investment toward projects with quick results, creating a crowding-out effect on early investment. However, as the long-term economic outlook improves, it stimulates more positive views from investors on long-term investments, leading to an increase in early investment efforts. The impact of manufacturing PMI on PE investment reveals an initial inhibitory effect for the first two periods, with a maximum suppression influence of up to 10%. Subsequently, the positive impact rapidly increases, reaching its peak of nearly 25% in the 4th period, followed by a fluctuating decline until it stabilizes. Regarding the impact of manufacturing PMI on RMB private equity investment, the impulse response curve also exhibits an initial inhibitory effect for the first two periods, with a maximum suppression influence of up to 10%. However, the suppressive effect weakens over time, and the positive impact fluctuates and increases. It peaks at 15% in the 4th and 6th periods, followed by a fluctuating decline until it stabilizes. As for the impact on foreign currency private equity investment, the impulse response curve also indicates an initial inhibitory effect for the first two periods, with a maximum suppression influence of up to 10%. However, the suppressive effect weakens over time, and the positive impact fluctuates and increases. It peaks at nearly 20% in the 8th and 10th periods, followed by a decline in influence. Compared to RMB private equity investment, the impact of manufacturing PMI on foreign

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currency private equity investment lasts for a longer period, indicating an increase in manufacturing PMI stimulates the growth of foreign currency private equity investment for an extended period.

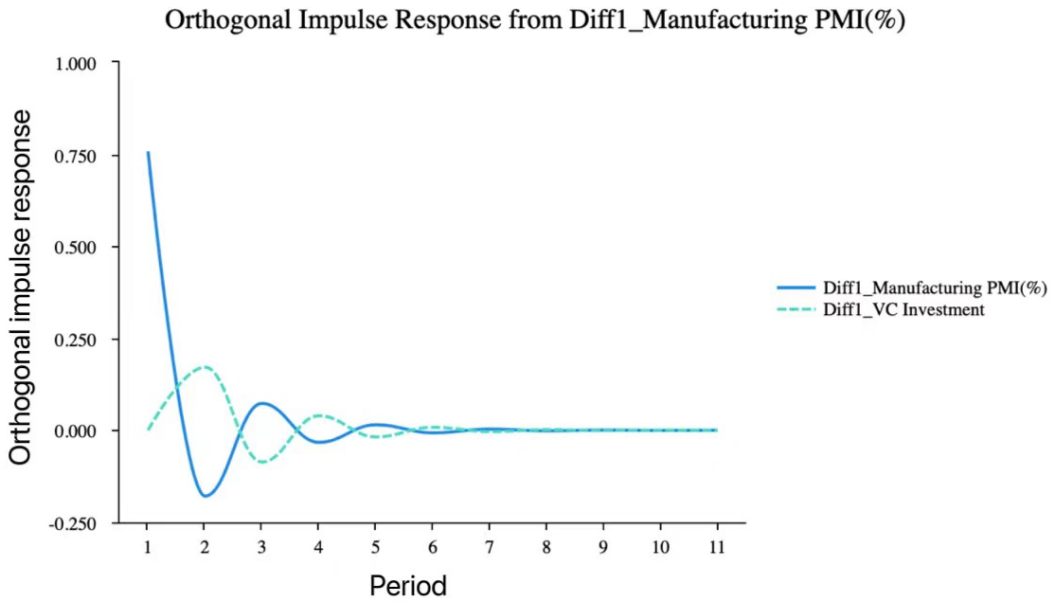

Figure 5: Impulse response of VC Investment Increment to Manufacturing PMI increment changes. (Photo/Picture credit: Original).

As illustrated in Figure 5, the impact of manufacturing PMI on early investment demonstrates a rapid and significant positive response. It reaches its peak of nearly 25% in the 2nd period, followed by a fluctuating decline, and subsequently stabilizes after the 5th period.

4.3. Variance Decomposition

Table 5: Variance decomposition table-Manufacturing PMI(%).

Period	Variance Decomposition of S.E.	Manufacturing PMI (%)	Private Equity Investment (%)	Early Investment (%)	PE Investment (%)	RMB Private Equity Investment (%)	Foreign Currency Private Equity Investment (%)
1	0.780	100.000	0.000	0.000	0.000	0.000	0.000
2	0.924	82.636	12.183	0.889	0.861	1.413	2.018
3	1.011	76.342	15.463	3.445	1.286	1.695	1.770
4	1.057	69.925	17.056	3.305	5.245	2.430	2.040
5	1.111	65.280	19.339	4.413	6.888	2.232	1.847
6	1.249	52.509	20.631	14.133	8.088	2.556	2.083
7	1.313	48.521	19.747	18.589	7.600	3.033	2.510
8	1.399	42.745	17.750	26.090	6.912	2.726	3.777
9	1.461	39.616	19.661	26.619	7.066	2.799	4.239
10	1.497	37.907	20.165	26.382	7.197	3.173	5.175

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From the variance decomposition provided in Table 5, it can be observed that manufacturing PMI has the largest impact on itself, with a 20% explanatory power over a 10-period horizon. Manufacturing PMI has almost no immediate impact on current private equity investment, but its influence grows rapidly and persists for a considerable duration. The impact reaches its peak of 20% in the 6th period and gradually declines. Remarkably, even in the 10th period, manufacturing PMI still contributes to 38% of the variation in private equity investment. The impact of manufacturing PMI on early investment reaches its peak of 27% in the 9th period. The impact on PE investment reaches its peak of 8% in the 6th period. The impact on RMB private equity investment reaches its peak of 3% in the 10th period, while the impact on foreign currency private equity investment reaches its peak of 5% in the 10th period. These findings highlight the leading characteristic of PMI in influencing these investment categories.

Table 6: Variance decomposition table-Diff1 of Manufacturing PMI (%).

Period	Variance Decomposition of S.E.	Diff1_Manufacturing PMI (%)	Diff1_VC Investment (%)
1	0.758	100.000	0.000
2	0.798	95.378	4.622
3	0.805	94.326	5.674
4	0.807	94.110	5.890
5	0.807	94.065	5.935
6	0.807	94.056	5.944
7	0.808	94.054	5.946
8	0.808	94.054	5.946
9	0.808	94.054	5.946
10	0.808	94.054	5.946

From the variance decomposition presented in Table 6, it can be found that the growth of manufacturing PMI has a stable and long-lasting impact on itself. It maintains a high explanatory power of around 94-95% from the 2nd to the 10th period. The impact of the growth of manufacturing PMI on the increment of early investment is also stable and persistent. It maintains an explanatory power of 5.6%-5.95% from the 3rd to the 10th period.

5. Conclusion

The following conclusions can be drawn through the above analysis: Firstly, the correlation and regression analysis between manufacturing PMI and private equity investment reveals a moderate level of correlation between the two variables. Specifically, it is observed that manufacturing PMI can provide a certain level of predictability for private equity investment with a lead time of one to two quarters, explaining approximately 27.7% of the variation in private equity investment. Similar correlation characteristics were observed when examining different investment stages, including early investment, VC investment, and PE investment, although the degree of correlation may vary slightly. Furthermore, there is a stronger correlation between manufacturing PMI and foreign currency private equity investment compared to RMB private equity investment, indicating that foreign currency investors pay closer attention to the macroeconomic conditions of specific countries. Secondly, the VAR model analysis highlights the correlation and impact of manufacturing PMI on private equity investment. The results clearly indicate a significant positive influence of manufacturing PMI on private equity investment. Notably, there are significant positive impacts observed at lags of two and six periods. Similar patterns were observed in the correlation and impact

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analysis between manufacturing PMI and VC investment. These findings not only align with the leading indicator characteristics of PMI but also emphasize the role of private equity investment as a as a “barometer” of the capital market. Thirdly, the VAR model analysis reveals the correlation and impact of manufacturing PMI on various investment categories, including early investment, PE investment, VC investment, RMB private equity investment, and foreign currency private equity investment. The findings indicate that manufacturing PMI initially has a suppressing effect on these indicators, which varies in magnitude. However, it later demonstrates positive effects. Notably, the impact on early investment stands out as the most significant, with an impact exceeding 20%.

The above-mentioned correlation relationships should be adequately applied in practical settings. Firstly, by monitoring manufacturing PMI, investors can make predictions about investment trends and prepare investment strategies in advance. Governments can also proactively adjust financial policies to stimulate investment recovery during favorable economic cycles, while also preparing counter-cyclical policies to mitigate potential investment downturns. Additionally, understanding the correlation between manufacturing PMI and investment can assist policymakers in better timing the implementation of policy measures, such as tax regulations, to achieve desired policy outcomes. Secondly, government-guided funds can play an effective role in identifying the timing and target areas of impact, enabling better guidance for private equity funds to leverage their strengths in early, small-scale, and technology-focused investments. This, in turn, can contribute to an increase in the proportion of direct financing and better serve the high-quality development of the real economy. Thirdly, mitigating the limitations imposed by lag constraints of private equity investment data can offer a fresh perspective for studying and analyzing private equity investments. It is important to note that the data utilized in this study is derived from comprehensive surveys, and as such, there may be limitations in the operation of certain variables. Further comprehensive research is required to delve deeper into the exploration of government-guided funds in the future.

References

[1] *Zhu, W. (2023). Analysis and Research on the Current Development of Private Equity Funds and Countermeasures in China. China Management Informatization, 3, 133-137.*

[2] *Huang, J. (2023). The Impact of Private Equity Investment on Corporate Value and Performance. China Circulation Economy, 5, 93-95.*

[3] *Sheng, Y., Yang, G. (2016). A Study on the Correlation between Manufacturing PMI and the Stock Market. Journal of Qiqihar University, 2, 49-53.*

[4] *Zhang, C. (2023). Correlation between Official PMI Index and CSI 800. Economic Research, 3, 55-57.*

[5] *Yang, S. (2018). An Empirical Study on the Relationship between the Shanghai Shenzhen CSI 300 and China’s Manufacturing PMI. Modern Communication, 9, 63-65.*

[6] *Ren, J., Li, X., Cao, L. (2023). Manager Mobility and Private Equity Syndications from the Perspective of Coupling Networks: Evidence from China's Private Equity Industry. Journal of Social Computing, 4(2), 150-167.*

[7] *Wilson, R. (1968). The theory of syndicates. Econometrica, 36(1), 119-132.*

[8] *The SPSSAU project (2023). SPSSAU. Retrieved from https://www.spssau.com.*

[9] *Sun, D. (2000). Selection of the Linear Regression Model According to the Parameter Estimation. Wuhan University Journal of Natural Sciences, 5(4), 400-405.*

[10] *William, H. (1998). Greene. Econometric Analysis. Beijing: China Social Sciences Press.*